Research Report

# Effects of Lesion Laterality on Cardiovascular Responses of Post Stroke Hemiparetic Patients to a Single Bout of Exercise

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**Abstract:** The aim of this study was to determine how hemiparetic stroke patients with dominant or non-dominant side brain lesion respond to a single bout of exercise. Participants were 14 dominant (DSH) and 17 non-dominant side hemiparetic (NDSH) stroke patients recruited from among those receiving physiotherapy on an outpatient basis at the University College Hospital in Ibadan, Nigeria. Twenty age-matched individuals with no known neurological impairments served as the control group (CG). Pre-exercise systolic (SBP) and diastolic blood pressure (DBP), heart rate (HR) and rate pressure product (RPP) were assessed. Participants performed a 6-minute level ground walk test at their own selected walking speed, after which their immediate post-walk cardiovascular parameters were determined. One-way ANOVA revealed no significant difference in the baseline cardiovascular parameters across the three groups; the NDSH group recorded significantly higher HR than their DSH counterparts. Post walk mean values showed significant difference in all but one (HR; $p = 0.10$) of the cardiovascular parameters of the three groups. *Post hoc* analyses showed no significant difference in the post walk SBP and DBP of the DSH and NDSH groups, but the NDSH group had significantly higher RPP than the DSH group. The within-group comparison showed that the exercise caused significant increase in HR (NDSH, CG), SBP (DSH, NDSH), DBP and RPP (all groups) of the participants. The results suggest that laterality had no significant effect on cardiovascular response of hemiparetic stroke patients to the exercise. However, when compared with non-stroke apparently healthy individuals, both groups of hemiparetic stroke subjects recorded significantly higher SBP, DBP and RPP responses to the 6-minute walk test.

**Key words: cardiovascular, cerebral dominance, exercise, hemiparesis, stroke**

## Introduction

Walking is an important measure of recovery in post stroke management. Inability to walk effectively in post stroke individuals is often a result of reduced exercise capacity, as they tend to show evidence of exertion after walking a short distance. It has been suggested that the low peak exercise responses in those individuals could be due to a number of factors including decreased number of motor units available for recruitment during dynamic exercise, the reduced oxidative capacity of paretic muscles and decreased overall endurance [1]. For those who have regained this function, the energy cost of walking is higher when compared to their age-matched counterparts who have not suffered a stroke [2]. It is therefore important that the physiotherapist assesses the capacity of these patients, in terms of cardiovascular adjustment, to carry out tasks such as walking, using standardized test protocol before engaging them in walking or other endurance exercise training activities aimed at improving their coordination, endurance and general function.

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Received: 4 October 2005 Accepted: 16 August 2006
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Functional walk tests such as the 6-minute walk test (6MWT) [3] and 12-minute walk test [4] are submaximal measures used to determine the functional capacity of individuals with compromised ability such as stroke. Eng et al [5], however, suggested that the 6MWT may be used as a clinical measure of cardiovascular endurance in adults with stroke.

One of the two cerebral hemispheres, depending on the dominant and the non-dominant hemisphere [6], predominantly performs certain functions. Hence, there are differences in difficulties experienced by individuals with damage to any of the two cerebral hemispheres. Lesion laterality has been reported to influence factors such as functional independence on admission, and regaining self-care and mobility in non-haemorrhagic stroke survivors [7]. This study was carried out to investigate the differential effects of cerebral dominance on the cardiovascular response and speed of walking of hemiparetic stroke subjects and non-stroke individuals to a 6-minute level ground walking exercise test.

## Methods

The research design was a pre-test, post-test study. The subjects for this study were 17 non-dominant (NDSH) and 14 dominant side hemiparetic (DSH) stroke subjects. Nineteen had suffered haemorrhagic stroke and 12 had ischaemic cerebrovascular disease. The mean duration of stroke was $15.28 \pm 3.65$ weeks. Twenty apparently healthy individuals constituted the control group.

The inclusion criteria for participation for the hemiparetic subjects were as follows: hemiparetic stroke subjects who possessed adequate balance for independent standing determined by ability to bear at least 30% of total weight on the affected lower limb on standing for at least 2 minutes [2]; independent ambulation without any assistive device; resting systolic (SBP) and diastolic blood pressure (DBP) not exceeding mild hypertension values of 160 mmHg and 95 mmHg respectively [8]; Grade 2 spasticity level in the upper and lower limbs on the Ashworth scale [9].

Participation criteria for the subjects in the control group were: resting SBP and DBP not exceeding mild hypertension values of 160 mmHg and 95 mmHg respectively [8]; no history of any neurological and musculoskeletal disorder that resulted in functional abnormality of the lower limbs.

Participants were recruited consecutively from among those receiving physiotherapy on an outpatient basis. Handedness (dominance) was determined through a brief interview where the following questions were asked: which hand would you preferentially use for: a. writing; b. eating; c. sweeping; d. cutting grass; e. throwing a ball; f. holding a tennis racket; g. opening or closing doors and window shutters; h. which leg would you preferentially use to kick a ball while playing soccer?

Subjects who favoured right over the left while replying to questions a–h were considered to be right handed and thus left cerebral dominant, while those who favoured left over right were considered to be left handed and thus right cerebral dominant [10]. The questions were asked with respect to the limb preference before the stroke incident. The term *dominance* was used in this study with respect to the side of hemispheric lesion.

### *Procedure*

The study protocol was approved by the institutional review board of the University of Ibadan/University College Hospital. The details of the procedure were explained to each subject before obtaining their informed consent.

The following information were obtained from the subjects and recorded as appropriate: gender; age at last birthday; occupation; marital status; date of cerebrovascular accident; duration of treatment received. Their weight, height and weight symmetry were also determined. To measure weight symmetry, two digital portable weighing scales were placed beside each other, 10 cm apart on the floor at the research venue, and the subject stood fully upright and unsupported with a foot on each of the scales [11].

After subjects had sat at rest for 20 minutes in the gymnasium where the study took place, resting (baseline) blood pressure was measured at the subject's unaffected arm using a mercury-in-glass sphygmomanometer and a stethoscope, while the heart rate (HR) was counted as pulse rate, determined manually by palpating the pulse at the radial artery and using a stopwatch for timing. From the measurements taken, the rate pressure product (RPP) was computed for each participant as: $RPP = SBP \times HR$. The RPP is a useful index of cardiac stress and a valid predictor of myocardiac oxygen consumption [12].

To calculate subjects' walking speed, subjects walked on a mapped area that was 10 metres in length in the physiotherapy gymnasium without resting in between. They did not use any walking aid and they chose their own pace for the 6-minute period of the walking exercise test. Subjects were told that their goal was to cover as much ground as they could in 6 minutes. On the command "Go!" they started to walk and the stopwatch was started. At the $6^{th}$ minute, the walking was terminated and subjects were asked to sit. The immediate post-walk cardiovascular variables were measured, and from the distance covered in 6 minutes, walking speed (in metres/second) was determined as the total distance covered (in metres) divided by the time taken (in seconds) to cover the distance.

$$\text{Walking speed (m/s)} = \frac{\text{Total distance (m)}}{6 \times 60 \text{ (s)}}$$

**Table 1. Physical characteristics of subjects ($n = 51$)***

| | DSH ($n = 14$) | NDSH ($n = 17$) | Control ($n = 20$) |
|---|---|---|---|
| Age (yr) | 60.57 ± 8.06 | 58.82 ± 9.08 | 53.55 ± 15.20 |
| Height (m) | 1.62 ± 0.17 | 1.62 ± 0.90 | 1.63 ± 0.73 |
| Weight symmetry | 1.05 ± 0.17 | 1.03 ± 0.11 | 1.03 ± 0.14 |

*Data are presented as mean ± standard deviation. DSH = dominant side hemiparetic stroke patients; NDSH = non-dominant side hemiparetic stroke patients.

**Table 2. Comparison of mean pre-6-minute walk test cardiovascular parameters of subjects ($n = 51$)***

| | DSH ($n = 14$) | NDSH ($n = 17$) | Control ($n = 20$) | $p$ | *Post hoc* analyses | | |
|---|---|---|---|---|---|---|---|
| | | | | | DSH *vs.* NDSH | DSH *vs.* Control | NDSH *vs.* Control |
| SBP (mmHg) | 123.0 ± 27.32 | 129.64 ± 12.16 | 123.50 ± 17.48 | 0.63 | NS | NS | NS |
| DBP (mmHg) | 83.53 ± 8.80 | 85.71 ± 7.56 | 80.20 ± 9.80 | 0.21 | NS | NS | NS |
| HR (bpm) | 74.47 ± 8.23 | 81.43 ± 9.91 | 75.60 ± 8.12 | 0.07 | Sig | NS | NS |
| RPP | 9,264.71 ± 2,408.03 | 1,059.00 ± 1,881.65 | 9,349.50 ± 1,714.53 | 0.14 | NS | NS | NS |

*Data are presented as mean ± standard deviation. DSH = dominant side hemiparetic stroke patients; NDSH = non-dominant side hemiparetic stroke patients; SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate; RPP = rate pressure product; NS = non-significant difference; Sig = significant difference.

Subjects were closely monitored throughout the course of the 6MWT to avoid any untoward physical and medical incidents. All participants completed the walk test without resting in between. They were asked to sit for 30 minutes after the completion of the test to monitor them before they could leave the gymnasium.

Patients continued with their regular physiotherapy sessions, following their appropriate appointment schedule, after participating in this study.

### *Data analyses*

Means and standard deviations were computed for all the variables determined. One-way analysis of variance (ANOVA) was used to compare each of the pre- and post-6MWT parameters and walking speed among the DSH, NDSH, and control groups. Paired $t$ test was used for within-group pre- and post-walk cardiovascular variables. The level of significance was set at 0.05 alpha.

## Results

The physical characteristics of the subjects are presented in Table 1. The outcome of data analyses showed that there was no significant difference in the pre-6MWT cardiovascular parameters of the three groups of subjects, although HR showed a trend of highest mean values for the NDSH group (Table 2). *Post hoc* analyses revealed that the NDSH group had significantly higher pre-6MWT HR than their DSH counterparts. No significant difference was found between the control group and each of the DSH and NDSH groups. The results as indicated in Table 3 showed no statistically significant difference in the post-6MWT HR of the three groups of subjects ($p = 0.10$). Significant differences were found in post-6MWT SBP ($p = 0.00$), DBP ($p = 0.02$), and RPP ($p = 0.02$) across the three groups. *Post hoc* analyses were carried out to identify the group pair that recorded significant difference.

There was a significant difference in the mean walking speed values ($p = 0.00$) of the three groups of subjects (Table 4). Although *post hoc* analyses showed no significant differences in the walking speed of the DSH and NDSH groups, each of them recorded significantly lower walking speed than their control counterparts (Table 4). Pearson's product moment correlation coefficient (Table 5) revealed little if any correlation [13] between cardiovascular responses and each of speed and distance in the stroke group. A similar trend was observed in the control group. Within-group comparisons of mean resting (pre-) and immediate post-walk cardiovascular parameters in each of the three groups showed that the exercise caused significant increase in all the variables in the NDSH group, whereas HR ($p = 0.06$) and SBP ($p = 0.40$) were not significantly increased by the exercise in the DSH and apparently healthy control groups, respectively (Table 6).

**Table 3. Comparison of mean post-6-minute walk test cardiovascular parameters of subjects (*n* = 51)***

| | DSH ($n = 14$) | NDSH ($n = 17$) | Control ($n = 20$) | $p$ | *Post hoc* analyses | | |
|---|---|---|---|---|---|---|---|
| | | | | | DSH *vs.* NDSH | DSH *vs.* Control | NDSH *vs.* Control |
| SBP (mmHg) | 140.29 ± 9.27 | 143.93 ± 10.41 | 125.75 ± 17.49 | 0.00 | NS | Sig | Sig |
| DBP (mmHg) | 90.29 ± 8.74 | 92.14 ± 6.99 | 83.50 ± 10.89 | 0.02 | NS | Sig | Sig |
| HR (bpm) | 86.94 ± 23.56 | 99.00 ± 9.34 | 91.50 ± 8.00 | 0.10 | NS | NS | NS |
| RPP | 12,184.71 ± 3,467.05 | 14,282.50 ± 1,946.87 | 11,572.50 ± 2,264.57 | 0.02 | Sig | Sig | Sig |

*Data are presented as mean ± standard deviation. DSH = dominant side hemiparetic stroke patients; NDSH = non-dominant side hemiparetic stroke patients; SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate; RPP = rate pressure product; NS = non-significant difference; Sig = significant difference.

**Table 4. Comparison of mean walking speed of subjects (*n* = 51)***

| | DSH ($n = 14$) | NDSH ($n = 17$) | Control ($n = 20$) | $p$ | *Post hoc* analyses | | |
|---|---|---|---|---|---|---|---|
| | | | | | DSH *vs.* NDSH | DSH *vs.* Control | NDSH *vs.* Control |
| Speed (m/s) | 0.42 ± 0.38 | 0.25 ± 0.13 | 1.14 ± 0.25 | 0.00 | NS | Sig | Sig |

*Data are presented as mean ± standard deviation. DSH = dominant side hemiparetic stroke patients; NDSH = non-dominant side hemiparetic stroke patients; NS = non-significant difference; Sig = significant difference.

**Table 5. Correlation between cardiovascular responses and speed and distance covered by subjects (*n* = 51)**

| | SBP (δ) | DBP (δ) | HR (δ) | RPP (δ) |
|---|---|---|---|---|
| DSH ($n = 14$) | | | | |
| Speed (m/s) | −0.16 | −0.30 | 0.09 | −0.00 |
| Distance (m) | −0.17 | −0.28 | 0.08 | −0.01 |
| NDSH ($n = 17$) | | | | |
| Speed (m/s) | −0.07 | 0.33 | 0.19 | 0.10 |
| Distance (m) | −0.14 | 0.47 | 0.14 | −0.02 |
| Control ($n = 20$) | | | | |
| Speed (m/s) | 0.18 | −0.06 | −0.06 | 0.17 |
| Distance (m) | 0.17 | −0.06 | 0.07 | 0.16 |
| DSH + NDSH ($n = 31$) | | | | |
| Speed (m/s) | −0.07 | 0.11 | 0.04 | 0.01 |
| Distance (m) | 0.09 | −0.03 | 0.02 | 0.04 |

SBP (δ) = systolic blood pressure response (post-exercise value minus pre-exercise value); DBP (δ) = diastolic blood pressure response (post-exercise value minus pre-exercise value); HR (δ) = heart rate response (post-exercise value minus pre-exercise value); RPP (δ) = rate pressure product response (post-exercise value minus pre-exercise value).

## Discussion

The exercise test used in this report was level-ground walking. Walking is a natural form of rhythmical exercise that requires no equipment and that can be self-administered by patients undergoing rehabilitation both in the clinical setting and in the community. The 6MWT, which was recommended as a useful clinical measure of cardiovascular endurance in adults with stroke [14], has also been used for apparently healthy subjects of both sexes to construct predictor equations and to assess endurance in community-dwelling adults [15]. The usefulness of this test protocol is underscored by the fact that in a developing economy like Nigeria

**Table 6. Comparison of pre- and post-exercise parameters of subjects ($n$ = 51)***

| | Pre-exercise | Post-exercise | $t$ | $p$ |
|---|---|---|---|---|
| DSH ($n$ = 14) | | | | |
| SBP (mmHg) | 123.53 ± 27.32 | 140.29 ± 9.27 | 3.01 | 0.01† |
| DBP (mmHg) | 83.53 ± 8.80 | 90.29 ± 8.74 | 4.57 | 0.00† |
| HR (bpm) | 74.47 ± 8.23 | 86.94 ± 23.56 | 2.01 | 0.06 |
| RPP | 9,264.71 ± 2,408.03 | 12,184.71 ± 3,467.05 | 3.12 | 0.01† |
| NDSH ($n$ = 17) | | | | |
| SBP (mmHg) | 129.64 ± 12.16 | 143.93 ± 10.41 | 68.44 | 0.00† |
| DBP (mmHg) | 85.71 ± 7.56 | 92.14 ± 6.99 | 3.23 | 0.01† |
| HR (bpm) | 81.43 ± 9.91 | 99.00 ± 9.34 | 13.22 | 0.00† |
| RPP | 10,590.00 ± 1,881.63 | 14,282.14 ± 1,946.87 | 11.16 | 0.00† |
| Control ($n$ = 20) | | | | |
| SBP (mmHg) | 123.50 ± 17.48 | 125.75 ± 17.49 | 0.86 | 0.40 |
| DBP (mmHg) | 80.25 ± 9.80 | 83.50 ± 10.89 | 3.12 | 0.01† |
| HR (bpm) | 75.60 ± 8.12 | 91.50 ± 8.00 | 11.40 | 0.00† |
| RPP | 9,349.50 ± 1,714.53 | 11,572.50 ± 2,264.57 | 6.70 | 0.00† |

*Data are presented as mean ± standard deviation; †significant at $p < 0.05$. SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate; RPP = rate pressure product.

where this study was carried out, more sophisticated test facilities such as grid walkway and motorised treadmill machines are not readily available in clinics.

Subjects walked continuously for 6 minutes at their own pace. All the participants (both post-stroke and control subjects) were able to complete the 6MWT without any rest periods during the test. They also walked without any assistive device, and were closely monitored during the test to avoid any untoward event. The exercise caused a significant increase in all the cardiovascular parameters of NDSH stroke subjects, but caused no statistically significant increase in the HR of DSH stroke subjects. A trend of an increase in post-6MWT HR was, however, observed. Also, only SBP was not significantly increased by the exercise test in the control group. The significantly higher post-walk SBP, DBP and HR suggest that all the subjects (hemiparetic and control) experienced some cardiovascular stress during the 6MWT. These results probably reflect the fact that all subjects were exercise-deconditioned irrespective of whether they had suffered a stroke or not or whether they had dominant or non-dominant side stroke. HR has been reported to have a linear relationship with oxygen demands of the heart [12]. Therefore, it may be deduced that level-ground walking at their own selected walking speed placed a significantly higher oxygen demand on the hearts of the subjects as shown by the significant increase in post-exercise pulse after 6 minutes of walking.

At baseline (pre-6MWT), the three groups of participants were matched in all the cardiovascular parameters, except the NDSH group which had significantly higher HR than their DSH counterparts. This is underscored by the fact that none of the subjects had a history of habitual regular participation in exercise before this study. The significant difference in post-exercise SBP, DBP and RPP across the three groups therefore suggests that each group of participants responded differently to the 6MWT. The results showed that the DSH and NDSH groups recorded significantly higher mean post-exercise SBP, DBP and RPP than the control group, suggesting that hemiparetic subjects had lower cardiovascular adjustment to the exercise than their non-hemiparetic (control) counterparts. The NDSH group recorded significantly higher post-exercise actual exertion. According to Kispert [12], RPP (a measure of the level of actual exertion during an activity) is a useful index of cardiac stress and a valid predictor of myocardiac oxygen consumption. The observed trends of differential responses in RPP of the DSH and NDSH subjects might be a result of an association between side of affectation in stroke and the dynamics of muscular works involved in balancing and walking, especially post-stroke.

The walking speed of the three groups of subjects was significantly different, although there was no significant difference between the DSH and NDSH groups. Both groups of hemiparetic subjects, however, recorded slower speed values compared to control individuals. While the control group (apparently healthy subjects) had a mean walking speed of 1.14 m/s, the NDSH and DSH groups recorded a mean value of 0.42 m/s and 0.25 m/s, respectively. This trend is comparable to that found by Perry et al [16], who submitted that the walking speed of a normal adult is between 1.2 and 1.4 m/s, and that stroke patients tend to walk at less than 0.9 m/s and sometimes as slowly as 0.1 m/s. The differences in the speed at which the hemiparetic stroke subjects walked and the distance they covered during the 6MWT could not have significantly influenced the differential cardiovascular response by the subjects. This assertion is based on the fact that using the Munro [13] interpretation of the correlation analyses, little if any correlation was recorded between their cardiovascular responses and the speed at which they walked and the distance covered.

Whilst muscle weakness and loss of coordination are the primary impairments that affect walking after stroke, impaired cardiorespiratory and cardiovascular fitness have been reported to be a secondary limiting factor of walking endurance in stroke subjects when compared with apparently healthy individuals [17]. The findings of this current study suggest a need to take hemiparetic subjects through an exercise programme that is aimed at conserving energy during independent walking by improving endurance, as this would enhance their physical activities. Some researchers have observed that physical activity is a very cost-effective and more enjoyable health promotive measure in individuals with physical disability [18], as may be found in post-stroke individuals. However, Richard et al [14] submitted that the limitations in the 6MWT for adults with stroke, when compared with apparently healthy individuals, do not purely reflect poor cardiovascular fitness but also restrictions caused by motor and balance impairments related to stroke in endurance activities.

## Conclusion

The 6-minute level-ground walking caused significant increase in the cardiovascular parameters of both dominant and non-dominant side post-stroke hemiparetic subjects, with the non-dominant side lesion group recording higher mean HR. When compared with their apparently healthy age-matched counterparts, the hemiparetic subjects recorded higher post-exercise SBP, DBP and RPP. Little correlation was found between cardiovascular responses and speed and distance covered by the subjects. A major limitation to the generalization of the outcome of this study is the small sample size (31 hemiparetic and 20 control subjects).

## References


1. Potempa K, Lopez M, Brain L, et al. Physiological outcomes of aerobic exercise training in stroke patients. *Stroke* 1995; 26:101–5.
2. Hamzat TK. Effect of treadmill walking training on energy cost of ambulation in stroke patients. *Saudi J Disabil Rehabil* 2002;8:5–9.
3. Poh P, Duncan P, Perrera S, et al. The influence of stroke-related impairments on performance in the 6-minute walk test. *J Rehabil Res Dev* 2002;39:439–44.
4. Kosak M, Smith T. Comparison of 2-, 6-, and 12-minute walk tests in patients with stroke. *J Rehabil Res Dev* 2005;42:103–7.
5. Eng JJ, Chu K, Dawson AS, et al. Functional walk tests in individuals with stoke: relation to perceived exertion and myocardial exertion. *Stroke* 2002;33:756.
6. Murray L, John A. *Histology of the Cerebral Cortex. The Human Nervous System*, 6th edition. Philadelphia: Lippincott, 1993;102.
7. Chae J, Zorowitz R. Functional status of cortical and subcortical non-hemorrhagic stroke survivors and effect of lesion laterality. *Arch Phys Med Rehabil* 1998;77:415–20.
8. Akinkugbe OO (ed), and National Expert Committee on Non-Communicable Diseases in Nigeria. *Non-Communicable Diseases in Nigeria, Final Report of a Survey, 1997.* Lagos: Federal Ministry of Health.
9. Bohannon RW, Smith MB. Inter-rater reliability of a modified Ashworth scale of muscle spasticity. *Phys Ther* 1987;67:206–7.
10. Balogun JA, Onigbinde AT. Hand and leg dominance: do they really affect limb muscle strength? *Physiotherapy Theory and Practice* 1992;90–5.
11. Adegoke BOA, Akinkoye OO. The relationship between gender, motor function, period since stroke and asymmetry of lower limb weight distribution post stroke. *South African J Physiother* 2003;59:15–9.
12. Kispert CP. Clinical measurement to assess cardiopulmonary function. *Phys Ther* 1987;76:1886–90.
13. Munro BH. *Statistical Methods for Health Care Research*, 3rd edition. Philadelphia: JB Lippincott, 1997.
14. Richard C, Malouin F, Dean C. Gait in stroke. *Clin Geriatr Med* 1999;15:833–55.
15. Harada ND, Chiu V, Steward AL. Mobility-related function in older adults: assessment with a 6-minute walk test. *Arch Phys Med Rehabil* 1999;80:837–41.
16. Perry J, Garret M, Gronlay JK, Mulroy SJ. Classification of walking handicap in the stroke population. *Stroke* 1995;26: 982–9.
17. Kello J, Kilbreath S, Davis G, et al. Cardiorespiratory fitness and walking ability in subacute stoke patients. *Arch Phys Med Rehabil* 2003;84:1780–3.
18. Katsumura T, Hinman AD. Longer healthier lives. *World Health* 1997;4:31–4.